International Journal of Agricultural
Science and Research (IJASR)
ISSN (P): 2250-0057; ISSN (E): 2321-0087
Vol. 7, Issue 5, Oct 2017, 73-76

TRANS STELLAR
•Journal Publications •Research Consultancy

REMOTE SENSING AND GIS APPLICATIONS IN FRUIT INDUSTRY

D. NAGAHARSHITHA[1] & KUNAL A.G[2]

[1]*Sri Konda Laxman Telangana State Horticultural University-Rajendranagar - Hyderabad, India*

[2]*Pdkv, Akola, Maharshtra, India*

ABSTRACT

The fruit industry provides several benefits. In India, its operation can result in nutritional security, employment, livelihood, and ecological security. Fruit orchards are spread across the country in varied terrains and geographic environments. These orchards need specialized care and management for sustainable growth and development. Remote sensing (RS) and Geographical Information System (GIS) are new-edge technologies that facilitate in gathering and updating information to develop scientific management plans. Both these technologies are multifunctional. RS and GIS can classify crops, determine crop area and acreage, perform crop canopy measurements, calculate crop yield, analyze plant health, as well as involve in input management (nutrient and water). In addition to these applications, RS and GIS techniques are being increasingly applied to meet various other challenges such as better accurate yield models, identifying ways and means of reducing cost, time gap in collection, interpretation, and dissemination of data, gather conclusive evidence to establish its utility, and concentrate on human resource development to apply the process on large scale. Despite not having met its full potential to confront all its challenges, RS and GIS have remarkable scope for sustainable production of horticulture crops.

KEYWORDS: Remote sensing (RS) and Geographical Information System (GIS), Nutrient & Water

Received: Jul 25, 2017; **Accepted:** Aug 15, 2017; **Published:** Aug 28, 2017; **Paper Id.:** IJASROCT201710

Original Article

INTRODUCTION

Horticulture is fast emerging as one of the major thrust areas in the agriculture sector. For optimum utilization of available horticultural land resources on a sustainable basis, timely and reliable information regarding their nature, extent, and spatial distribution along with their potential and limitations is very important. The parameters crucial for crop growth and production are soil physiognomies (soil pH, nutrient levels, drainage efficiency, texture, permeability, and water holding capacity), climatic settings (temperature, rainfall, solar radiation, chilling hours, and growing degree days),type of land (soil properties and topography), plant population, fertilization, irrigation, and pest infestations. For efficient access to determine these physical factors and its variation, a geospatial database (Schumann and Zaman, 2004; Panda *et al*., 2011) is of paramount importance. RS systems provide regular, synoptic, multispectral, and multitemporal coverage of the crop area; therefore, they can be used to create an accurate database on spectral behavior of crops and variation in its growth environment, for example, changes in soil and atmosphere evaluations. This database can then be utilized by the respective farmer for applications such as crop inventory, determining crop condition, crop production forecasts, fruit quality determination, leaf area index measurement, crown cover analysis, detection of the growth and health of horticultural crops, drought and flood damage assessment, as well as range and irrigated land monitoring and management (Min *et al*., 2008a).

REMOTE SENSING GEOGRAPHICAL INFORMATION SYSTEM

Remote sensing comprises qualitative and quantitative information about far-flung objects from a distant location without direct contact (*look but no touch*).

GIS is a computer-based approach that can interpret maps and images produced by various technologies. The data so obtained is the implemented in problem solving.

PRINCIPLES AND ADVANTAGES

RS involves assembling data from a distance. However, this basic definition does not include the human eye, the human ear, disposable cameras, as well as radar, sonar, and satellite sensor arrays, which could also be classified as RS devices as per the definition. RS involves sensing and recording reflected or emitted energy and processing, analyzing, and applying that information. A vital feature of RS is its detection of radiant energy emitted by various objects. The energy it records may be in the form of acoustical energy (sound) or electromagnetic energy (light, infrared heat, ultraviolet waves, and microwaves). RS technology can be ground-, air-, or space-based. From all these varied platforms, RS can provide detailed spectral, spatial, and temporal information regarding vegetation health and vigor. RS technology is increasingly applied to estimate crop yield. The remote sensor is equipped with varied sensors including aerial photographs, airborne multispectral scanners, satellite imagery, low and high spatial and spectral resolution, and ground-based spectrometer measurements. All these various sensors collect electromagnetic information, which is easier for collection and for recording. The electromagnetic information is clubbed with the observation tools such as yield monitors, airborne optical RS, and soil-sensing instrumentation empowering the horticulturists to make more informed decisions related to desired productivity outcomes.

GEOGRAPHICAL INFORMATION SYSTEM (GIS): IN AGRICULTURE

Horticultural areas in India are spread across a wide geographical range. The problems and solutions to each location are unique. Integration of land and water resources and identification of the constraints/ecological problems at the micro level can help in identifying location-specific solutions. This can be achieved by the effective use of remote sensing based resource information combined with other socioeconomic data using GIS. These methods are in use for survey of resources at different scales using traditional and remote sensing techniques, collection of collateral information (slope, topography etc.), preparation of a set of resource maps (hydro geomorphology, soils, land use/cover, surface water/ drainage/ watershed, etc.) and generation of action plan maps giving site specific recommendations for development and management of agriculture, ground water recharge, fuel and fodder as well as for soil conservation/reclamation and afforestation.

LIST OF APPLICATIONS

The varied applications of RS and GIS technologies include the following:

- Estimation of Crop Area

Horticulture crops including vegetables are an essential commodity of the Indian diet, in addition to being a major source of income for the farmer. However, the production and consumption of horticultural goods keep fluctuating because of unreliable price and market. Therefore, early availability of reliable statistics regarding the coverage area of a particular crop could serve as useful information for market planning and export assessment. Satellite-based RS has proved to be

successful for assessing the supply scenario, basically by the application of land cover area estimation. Earlier, area was estimated 4–5 months before the harvest by historical trend economic analysis, surveys, and other tools; however, these methods were often not reliable. Therefore, the contribution of RS in area estimation of horticulture crops is now being explored.

- Crop Classification

The major categories of crops including forest, woodland, scrub, grassland, and mixed vegetation can be distinguished and identified by RS data. RS records the spectral characteristics of vegetation cover and helps in their identification. The horticultural crops may be bushes, shrubs, or trees with green leaves; therefore, their spectral signatures are somewhat similar to other healthy vegetation. Coconut plantations are usually grown in association with other fruit crops such as jackfruit, mango, bael, and banana, especially in Kerala. For distinguishing each species, multispectral photography was useful. This technique uses color patterns exhibited by them to differentiate the species (Dakshinamurti *et al*., 1971).

- Canopy Measurements

Airborne RS helps to collect information regarding canopy status can be easily collected. It is an emerging technology, and is popular in Presicion Viticulture research (Hall *et al*., 2002; Dobrowski *et al*., 2003; Lamb *et al*., 2004).

- Estimation of Crop Yield

The yield of various annual crops has been successfully determined by RS and GIS. However, only limited research has implemented yield estimation for fruit trees and vegetables using the same technology (Maja and Ehsani. 2010; Mann *et al*., 2010; Ehsani and Karimi, 2010). RS methodologies help farmers with final crop yield assessments and show accurate yield variations across fields or orchards. With harvester-mounted yield monitors, intensive yield data can be collected from a field. RS imagery allows this data to be evaluated more accurately.

- Plant Health Analysis

RS and GIS are the prevailing technologies for visualizing, diagnosing, and quantifying plant stress responses. Stress responses to temperature, drought, flooding, salinity, mineral toxicity, or infection may be analyzed. Any individual stress can impact a wide range of different physiological processes, which result in variation in the physical status of the crop. For example, drought directly causes stomata closure, which indirectly results in decreased photosynthesis rate, reduced growth, leaf wilting, and loss of important pigments such as chlorophyll. All these indirect responses are used for stress diagnosis by RS and GIS.

In addition, input management (nutrient and water), weed infestation, and harvest date prediction can be easily organized and managed by RS and GIS technologies.

CONCLUSIONS

Inappropriate land management practices cause deterioration of land quality and horticultural crop yields. Factors such as climate, soil properties and nutrients, crop canopy volume and biomass, water content, disease, weeds, insects, and crop variety vary crop yields. These factors can be measured using sensors and instruments such as field-based electronic sensors, spectral radiometers, airborne multispectral and hyper spectral RS, satellite imagery, and thermal imaging. RS and

GIS are fast proving their potential for applications in crop biomass detection, soil properties, soil moisture and nutrient content, green fruit counts, crop yield estimation, damage by biotic and abiotic stresses, etc. These technologies are authentic sources of information for identifying, classifying, mapping, monitoring, and planning of natural resources and disaster mitigation and management. RS and GIS have a promising future for site specific management, precision horticulture, market planning, and export.

REFERENCES

1. *Dakshinamurti, C., Krishnamurthy, B., Summanwar, A.S., Shanta, P. and Pisharoty, P.R., 1971. Remote sensing for coconut wilt. In: Proceedings of International Symposium on Remote Sensing of Environment, 1, Ann Arbor, MI, pp. 25-29.*
2. *Hall, A., Lamb, D.W., Holzapfel, B. and Louis. J., 2002.Optical remote sensing applications in viticulture- a review. Aust. J. Grape Win e Res. **8**: 36-47.*
3. *Dobrowski, S.Z., Ustin, S.L. and Wolpert, J.A., 2003. Grapevine dormant pruning weight prediction using remotely sensed data. Aust. J. Grape Wine, Res. **9**: 177-182.*
4. *Lamb, D.W., Wee don, M.M. and Ramley, R.G.V., 2004. Using remote sensing to predict grape phenolics and colour at harvest in a Cabernet Sauvignon vineyard: timing observations against vine phenology and optimizing image resolution. Aus. J. Grape Wine Res., **10**: 46-54.*
5. *Min, M., Ehsani, R. and Salyan I, M., 2008a. Dynamic accuracy of GPS receivers in citrus orchards. Appl. Eng. Agric. **24**(6): 861 -868.*
6. *Schumann, A.W., Hostler, K.H., Miller, W.M. and Zaman, Q.U., 2004. Sensor-based Automatic yield Monitoring for Manually Harvested Citrus. ASAE, St. Joseph, MI, ASAE Paper No. 041098.*
7. *Ehsani, R. and Karimi, D., 2010. Yield monitors for specialty crops. Advanced engineering systems for specialty crops: a review of precision agriculture for water, chemical, nutrient application, and yield monitoring. Agric. For. Res.**340**: 31-34, Special issue of Landbauforschung Vtilkenrode, Special Issue 340, 2010vTI.*
8. *Maja, J.M. and Ehsani, R., 2010. Development of a yield monitoring system for citrus mechanical harvesting machines. Precision Agric. J., **11**(5): 475- 487.*
9. *Mann, K.K., Schumann, A.W. and Obreza, T.A., 2010. Delineating productivity zones in a citrus grove using citrus production, tree growth and temporally stable soil data. Precision Agric., 16, http:// dx.doi.org/10.1007/s11119-010-9189-y.*
10. *Panda, S.S., Martin, J., Hoogenboom, G., 2011.Blueberry crop growth analysis using climatologic factors and multi-temporal remotely sensed imagery. In: Proceedings of the 2011 Georgia Water Resources Conference held at the University of Georgia.*